SECTION 32 11 11

ASPHALT TREATED PERMEABLE BASE (ATPB) (DRAINAGE LAYER)

PART 1 GENERAL

1.1 DESCRIPTION

This specification is for an Asphalt Treated Permeable Base (ATPB) to be used as a drainage layer in pavements on Tinker AFB, OK.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless specifically noted, the current edition of the reference shall be used.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 29	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Standard Test Method for Materials Finer Than the 75µ (#200) Sieve in Mineral Aggregates by Washing
ASTM C 127	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

ASTM C 131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 1097	Standard Specification for Hydrated Lime for Use in Asphalt Cement or Bituminous Pavement
ASTM D 75	Standard Practice for Sampling Aggregates
ASTM D 140	Standard Practice for Sampling Bituminous Materials
ASTM D 995	Standard Specification for Mixing Plants for Hot Mixed, Hot Laid Bituminous Paving Mixtures
ASTM D 2172	Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D 2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 3549	Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
ASTM D 4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
ASTM D 6373	Standard Specification for Performance Graded Asphalt Binder
ASTM D 6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus

ASTM D 7063 Standard Test Method for Effective Porosity and Effective Air Voids of Compacted Bituminous Paving Mixture Samples

1.3 SUBMITTALS

1.3.1 Government approval is required for all equipment, materials, and procedures. Submit the following in accordance with Section 01 33 00; SUBMITTAL PROCEDURES.

SD-01 Pre-Construction

Contractor Quality Control Plan
Materials Tests Reports

All pre-construction submittals shall be submitted, no sooner than 90 days, nor later than 30 days prior to the start of construction.

SD-03 Samples

Materials

SD-05 Design Data

Job Mix Formula

SD-06 Test Reports

Aggregates
Binder
Stripping Agent
Job Mix Formula
ATPB

SD-07 Certificates

Material Compliance
Equipment Specifications

1.4 EQUIPMENT

1.4.1 All mixing plants and equipment used in the performance of the work require Government approval. Submit plant and equipment data and specifications in accordance with Section 01 33 00; SUBMITTAL PROCEDURES.

1.4.2 All mixing plants and equipment shall be maintained in satisfactory working condition at all times.

1.4.3 Mixing Plant

1.4.3.1 The bituminous mixing plant shall conform to the requirements of ASTM D 995 with the following exceptions:

a. The ATPB shall be weighed on contractor furnished or public scales at the expense of the contractor. The scales shall be certified for accuracy every 90 days.

b. Quality control and acceptance shall be as required by these specifications and as approved in the Contractor Quality control plan.

c. The use of storage or surge bins for the temporary storage of hot asphalt mixtures will not be permitted.

1.4.3.1 The bituminous mixing plant shall be commercially manufactured with either automatic or semi-automatic controls.

1.4.3.2 The bituminous mixing plant shall be capable of consistently producing the mixture specified by the job mix formula (JMF).

1.4.4 Placement Equipment

1.4.4.1 An asphalt paving machine shall be used to place drainage layer material.

1.4.4.2 The paving machine shall be self-contained and self-propelled.

1.4.4.3 The paving machine shall be equipped with an activated screed or strike-off assembly that can be heated as necessary.

1.4.4.4 The paving machine shall be capable of spreading and finishing ATPB material to the specified thickness, smoothness, and grade.

1.4.4.5 The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.4.4.6 An alternate method may be used if it can be demonstrated that the method obtains the specified results and is approved by the Government.

1.4.4.7 If, during construction, it is found that the spreading and finishing equipment causes unacceptable displacement of the ATPB surface, the use of such equipment shall be discontinued and satisfactory equipment shall be provided by the contractor.

1.4.5 Compaction Equipment

1.4.5.1 A self-propelled, steel wheeled static roller weighing between 6 and 12 US tons shall be used to compact drainage layer material.

1.4.5.2 The roller shall be maintained in good operating condition.
1.4.5.3 The roller shall be capable of reversing without backlash.

1.4.5.4 The roller shall be capable of compacting the drainage layer without undue displacement of the material and without crushing the drainage layer aggregate.

1.4.5.5 The wheels of the roller shall be self-cleaning to prevent sticking of the drainage layer mix to the wheels.

1.5 QUALITY

1.5.1 Quality Control shall be as specified in Section 01 45 10; CONTRACTOR QUALITY CONTROL and herein.

1.6 ENVIRONMENTAL REQUIREMENTS

1.6.1 Place drainage layer material when the atmospheric temperature is above 40 degrees F and rising.

1.6.2 Areas of completed drainage layer and underlying courses that are damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specifications.

1.6.3 Areas of completed drainage layer and underlying courses that are contaminated by sediments, dust, dirt, or foreign material shall be corrected to meet specifications.

PART 2 PRODUCTS

2.1 The ATPB shall be composed of a mixture of aggregate, asphalt cement, and an anti-stripping agent.

2.1.1 AGGREGATE

2.1.1.1 Aggregates shall be crushed limestone from a source approved by the Oklahoma Department of Transportation for use in Asphalt Concrete.

2.1.1.2 Aggregate for use in the drainage layer shall meet the gradation requirements of Table 1 for the lift thickness (t) specified.

NOTE: The thicknesses shown in Table 1 are compacted lift thicknesses, not completed layer thicknesses.

2.1.1.3 Aggregate tests submitted pre-construction shall be performed within 120 days of the start of construction.

2.1.1.4 Pre-construction aggregate tests shall be as specified in Table 2.

2.1.1.5 Aggregate testing during construction shall be as specified in Table 3.

2.1.1.6 Aggregates shall be sampled in accordance with ASTM D 75.

2.1.1.7 Aggregate shall meet the deleterious materials and durability requirements of ASTM C 33, Table 3, Class 4S as modified in Table 2.

2.1.1.8 The percentage of flat and/or elongated particles in the portion retained on the 3/8″ sieve shall not exceed 10.

2.1.2 ASPHALT CEMENT

2.1.2.1 The asphalt cement shall be PG 64-22OK and shall conform to the requirements of ASTM D 6373 as modified by the ODOT.

2.1.2.2 Bituminous material shall be sampled in accordance with ASTM D 140.

2.1.3 ANTI-STRIPPING AGENT

2.1.3.1 The anti-stripping agent shall be hydrated lime conforming to the requirements of ASTM C 1097.

TABLE 1
DRAINAGE LAYER AGGREGATE GRADATIONS

	Percent Passing by Weight	
Sieve	Type DL-A t <= 4″	Type DL-B 4″ < t <= 6″
1″	-	95 - 100
3/4"	95 - 100	75 - 85
1/2"	65 - 75	55 - 65
3/8″	50 - 60	40 - 50
#4	20 - 30	15 - 25
#8	0 - 5	0 - 5
#200	0 - 1	0 - 1

2.1.4 JOB MIX FORMULA (JMF)

2.1.4.1 The JMF shall establish a single percentage of dry weight of aggregate passing each required sieve size.

2.1.4.2 The JMF shall establish a single percentage of asphalt cement to be added to the aggregate based on the weight of the total mix.

a. The minimum asphalt cement content shall be 2 percent by weight.

b. The maximum asphalt cement content shall be 3.5 percent by weight.

2.1.4.3 The JMF shall establish a single percentage of hydrated lime to be added based on the weight of the total mix.

a. The minimum lime content shall be 0.5 percent by weight.

b. The maximum lime content shall be 1.0 percent by weight.

2.1.4.4 The JMF shall establish a single temperature for the mix as it is discharge into the hauling units.

2.1.4.5 The JMF shall be tested for permeability according to the following:

a. The component aggregates shall be blended together, mixed with the specified amount of asphalt cement at a temperature of 250 degrees F and with the specified amount of hydrated lime.

b. Prepare a sample in accordance with ASTM D 6926 and compact at a temperature of 150 degrees F with 35 blows of standard Marshall Hammer.

c. Test for permeability in accordance with ASTM D 2434.

(1) The JMF shall have a minimum permeability of 750 feet per day.

(2) The JMF shall have a maximum permeability of 1500 feet per day.

TABLE 2
PRE-CONSTRUCTION MATERIAL TESTING

Material	Test	Method	Limits
Aggregate	Soundness	ASTM C 88	$MgSO_4$ 13% @ 5 Na_2SO_4 10% @ 5
Aggregate	Abrasion	ASTM C 131	40%
Aggregate	Flat and Elongated Particles	ASTM D 4791	10%
Aggregate, Coarse	Absorption	ASTM C 127	n/a
Aggregate, Fine	Absorption	ASTM C 128	n/a
Aggregate	Gradation	ASTM C 136	See Table 1
Aggregate	Material Finer Than 75µ	ASTM C 117	1%
Job Mix	Permeability	ASTM D 2434	750 minimum 1500 maximum
Job Mix	Porosity	ASTM D 7063	0.30 minimum
Job Mix	Density	ASTM D 2950	AS Approved

PART 3 EXECUTION

3.1 MIXING

3.1.1 Mixing shall be accomplished using equipment as described in section 1.4.

3.1.2 The moisture content shall be controlled so that the moisture content of the aggregate blend is less than 0.25 percent for aggregates with water absorption of 2.5 percent or less, and less than 0.5 percent for aggregates with water absorption greater than 2.5 percent.

3.1.3 The binder and anti-stripping agent shall be added to the preheated aggregate and mixed until thoroughly distributed throughout the mixture and the aggregates are uniformly coated.

3.1.4 The plant discharge temperature of the mix shall be maintained between 275 and 325 degrees F.

3.2 TRANSPORTATION

3.2.1 Transport ATPB material to the site in equipment and in a manner which prevents segregation and contamination of the materials.

3.3 PLACING

3.3.1 Placing shall be accomplished using equipment as described in section 1.4.

3.3.2 The laydown temperature of the ATPB material shall be maintained between 200 and 250 degrees F., as measured in the hopper of the paving machine.

3.3.3 Place ATPB material in lifts of uniform thickness.

3.3.3.1 Layers with a compacted thickness of 6 inches or less shall be placed in a single lift.

3.3.3.2 Layers with a compacted thickness of greater than 6 inches shall be placed in lifts of equal thickness.

3.3.3.3 No lift shall have a compacted thickness greater than 6 inches.

3.3.3.4 No lift shall have a compacted thickness less than 3 inches.

3.3.4 When placing ATPB material in multiple lifts the joints shall be offset according to the following:

3.3.4.1 Longitudinal joints shall be offset 1 foot from the joint in the lift below.

a. Plan the lifts so that the longitudinal joint in the topmost lift is at the centerline of crowned pavements.

3.3.4.2 Transverse joints shall be offset a minimum of 2 feet from the joint in the lift below.

3.3.4.3 Transverse joints shall be offset a minimum of 10 feet from joints in adjacent strips.

3.3.5 When placing adjacent strips, the screed shall overlap the previously placed strip 3 to 4 inches and sufficiently high to insure compaction will produce a smooth, dense joint.

3.3.6 Hand Placing

3.3.6.1 Where machine placing is impractical, the ATPB material shall be placed using hand tools.

3.3.6.2 The material shall be placed uniformly in a loose layer to prevent segregation.

3.3.6.3 The material shall conform to the required grade and thickness after compaction.

3.4 COMPACTION

3.4.1 Compaction shall be accomplished using equipment as described in section 1.4.

3.4.2 In areas not accessible by the rolling equipment, the ATPB shall be compacted with approved mechanical hand-operated tampers.

3.4.3 Compaction shall be accomplished when the temperature of the mix is between 150 and 100 degrees F.

3.4.4 Sufficient compaction equipment shall be furnished to handle the output of the plant.

3.4.5 Rollers shall operate at a speed no greater than 1.5 miles per hour.

3.4.6 Compaction Sequence

3.4.6.1 Start compaction from the outside edges of the paving lane and proceed to the centerline of the lift being placed.

3.4.6.2 The roller shall stay a minimum of one half of the roller width from the outside edge of the drainage layer being placed until the desired density is obtained.

3.4.6.3 The outside edge shall then be rolled.

3.4.7 Compact each lift of drainage material with three passes of the roller.

3.4.7.1 Verify the density and make adjustments to the number of passes, if required, to obtain the required density.

3.4.7.2 Excessive rolling resulting in crushing of aggregate particles shall be avoided.

3.5 FINISHING

3.5.1 Finish the top surface of the drainage layer after final compaction, as determined from the test section.

3.5.2 Make adjustments in rolling and finishing procedures to obtain grades and minimize segregation and degradation of the drainage layer material.

3.6 SHOULDERS

3.6.1 Place shoulder material along the edges of the drainage layer course in a quantity that will compact to the same thickness as the layer being constructed.

3.6.2 At least 3 feet width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each lift of the drainage layer.

3.7 ACCEPTANCE

3.7.1 SMOOTHNESS

3.7.1.1 Smoothness shall be checked with a straightedge 12 feet in length.

3.7.1.2 The straight edge shall be applied both longitudinally and transversely to the pavement lane.

3.7.1.3 The surface of the top lift shall be flat, plus or minus 3/8 inch.

3.7.1.4 All deviations greater than 3/8 inch shall be corrected in accordance with paragraph 3.9.

3.7.2 THICKNESS

3.7.2.1 Thickness shall be checked with 4 inch diameter cores in accordance with ASTM D 3549.

3.7.2.2 Thickness shall be verified at a minimum of once per every 500 square yards of placement.

3.7.2.3 Compacted thickness shall be as specified, plus or minus 1/2 inch.

3.7.2.4 All deviations greater than 1/2 inch shall be corrected in accordance with paragraph 3.9.

3.7.2.5 The job average thickness shall be the average of all measurements, excluding the uncorrected out of tolerance measurements.

3.7.2.6 The job average thickness shall be equal to the specified thickness, plus or minus 1/4 inch.

3.7.3 GRADE

3.7.3.1 Finished grade of the ATPB shall be verified by a licensed surveyor with an engineering level.

3.7.3.2 Grade measurements shall be taken transversely at each edge and at the center of the laydown width for laydowns less than or equal to 12 feet.

3.7.3.3 Grade measurements shall be taken transversely at each edge and at the 1/4 points for laydown widths greater than 12 feet.

3.7.3.4 Grade measurements shall be taken longitudinally in increments equal to the laydown width.

3.7.3.5 Finished grade of the ATPB shall be as specified, plus or minus 1/2 inch.

3.7.3.6 All deviations greater than 1/2 inch shall be corrected in accordance with paragraph 3.9.

3.7.4 ASPHALT CONTENT

3.7.4.1 Asphalt content shall be verified each placement.

3.7.4.2 Samples for extraction shall be taken at the plant 30 minutes after the start of production and then at 4 hour intervals.

3.7.4.3 Samples shall be tested in accordance with ASTM D 2172.

3.7.4.4 Bitumen content shall be as specified in the approved JMF.

3.7.5 EXTRACTED AGGREGATE GRADATION

3.7.5.1 Gradation of the aggregates in the mix shall be verified each placement.

3.7.5.2 Samples taken in 3.7.4 shall be tested in accordance with ASTM D 5444.

3.7.5.3 Aggregate gradations shall be as specified in the approved JMF.

3.7.6 PERMEABILITY

3.7.6.1 Permeability shall be verified at a minimum of once per every 500 square yards of placement.

3.7.6.2 Permeability testing shall be in accordance with ASTM D 2434.

3.7.6.3 Permeability shall be greater than 750 feet per day and less than 1500 feet per day.

3.7.7 POROSITY

3.7.7.1 Porosity shall be verified at a minimum of once per every 500 square yards of placement.

3.7.7.2 Porosity testing shall be in accordance with ASTM D 7063.

3.7.7.3 Porosity shall be greater than 0.30.

3.7.8 DENSITY

3.7.8.1 Density shall be verified at a minimum of once per every 500 square yards of placement.

3.7.8.2 Density testing shall be in accordance with ASTM D 2950.

3.7.8.3 Density shall be as approved during pre-construction testing.

TABLE 3
ACCEPTANCE TESTING

Material	Test	Method	Limit	Frequency
Aggregate	Flat and Elongated Particles	ASTM D 4791	10%	Weekly
Aggregate	Gradation	ASTM C 136	See Table 1	Daily
Aggregate	Material Finer Than 75µ	ASTM C 117	1%	Daily
Aggregate	Moisture Content	ASTM C 566	.25% if abs <= 2.5% .5% if abs > 2.5%	Daily
JMF	Bitumen Extraction	ASTM D 2172	Approved JMF	See 3.7.4.2
JMF	Gradation	ASTM D 5444	Approved JMF	See 3.7.4.2
ATPB	Permeability	ASTM D 2434	750 minimum 1500 maximum	1 @ each 500 yd^2
ATPB	Porosity	ASTM D 7063	0.30 minimum	1 @ each 500 yd^2
ATPB	Density	ASTM D 2950	As Approved	1 @ each 500 yd^2

3.8 PROTECTION

3.8.1 The ATPB shall be maintained and protected during its construction and until the next higher layer has been placed.

3.8.2 Drainage shall be maintained such that fine material is not allowed to wash into or clog the drainage layer.

3.8.3 No traffic of any type shall be allowed on the ATPB until it has stabilized at ambient temperature.

3.8.4 Only equipment necessary for the construction of the next layer shall be allowed on the completed ATPB.

3.9 DEFICIENCIES

3.9.1 GRADE and THICKNESS

3.9.1.1 Correct deficiencies in grade and thickness so that both grade and thickness tolerances are met.

3.9.1.2 Thin layers of material shall not be added to the top surface of the drainage layer to meet grade or increase thickness.

3.9.1.3 If the elevation of the top of the drainage layer is more than 1/2 inch above the plan grade it shall be trimmed to grade and finished.

3.9.1.4 If the elevation of the top surface of the drainage layer is 1/2 inch or more below the required grade, the surface of the drainage layer shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and re-compacted to bring it to grade.

3.9.1.5 Where the measured thickness of the drainage layer is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replaced with new material to obtain a compacted lift thickness of at least 3 inches.

3.9.1.6 The depth of required excavation shall be controlled to keep the final surface elevation within grade requirements and to preserve layer thicknesses of materials below the drainage layer.

3.9.2 SMOOTHNESS

3.9.2.1 Correct deficiencies in smoothness as if they are deficiencies in grade or thickness.

3.9.2.2 All tolerances for grade and thickness shall be maintained while correcting smoothness deficiencies.

- End of Section -